MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (PROGRAMME ELECTIVE)
END SEMESTER EXAMINATIONS, DEC-JAN 2020-21
SUBJECT: ANALYTICAL TECHNIQUES AND INSTRUMENTATION
[CHM 4001]
REVISED CREDIT SYSTEM

Time: 3 Hours   MAX. MARKS: 50

Instructions to Candidates:
- ❖ Answer **ALL** the questions.
- ❖ Missing data may be suitably assumed.
- ❖ Draw diagrams and write equations wherever necessary.

1A. Give reasons for the followings:
  i) Conductometric titrations provide unsatisfactory results for precipitation titrations.
  ii) Measured conductance values decreases till the equivalence point and then remains constant in the titration of strong acid against weak base.

1B. Define the term column resolution. Discuss the effect of following factors on the resolution of chromatographic column.
  i) Length of the column
  ii) Band broadening

1C. What are the two different phases of high performance liquid chromatography? Describe the instrumentation and working of HPLC.

[2+3+5]

2A. Name the indicator electrode used in the redox titrations in potentiometric methods. Explain the variation of pH in the neutralization titrations.

2B. Explain, the procedure for the sample application, development and evaluation of chromatogram in thin layer chromatography.

2C. Explain, why the open tubular columns are frequently used in gas chromatography over packed columns? Describe the instrumentation and working of Gas chromatography with a schematic sketch.

[2+3+5]

3A. Calculate the frequency and energy of a typical visible radiation of wave length 480 nm.

3B. Show that the separation between the successive lines in Rotational Raman Spectra of diatomic molecule is 4B. The first three rotational Raman lines of a linear molecule are at 4.86, 8.14 and 11.36 cm^{-1} from the exciting Raman line. Estimate the rotational constant and the moment of inertia of the molecule.

3C. What are the basic principles of thermal and pyroelectric detectors of IR spectrograph? Explain their working with two examples for each.

[2+3+5]

4A. What is Born – Oppenheimer approximation? Explain the various energies associated with molecules and give their expressions.

4B. Explain the principle of microwave spectroscopy. Explain the microwave active and inactive compounds with suitable examples.

4C. Derive an expression for the frequency of absorption ($\bar{\nu}$) of a diatomic molecule considering it as anharmonic oscillator and non-rigid rotator. Illustrate the fundamental vibrational frequencies observed in the infrared spectrum of water molecule.

[2+3+5]

5A. Give reason – i) Aniline has maximum UV absorption (λ_{max}) at 280 nm while, in acidic medium the λ_{max} shifts to 200 nm. ii) Commercial ethanol cannot be used as a solvent for recording UV spectra.

5B. i) Explain the shielding effect in ^1H NMR spectroscopy by taking methane and chloromethane as examples.

ii) Discuss the splitting pattern and their intensities in the ^1H NMR spectrum of ethyl bromide.

5C. Discuss four applications of rotational spectroscopy. The separation of the lines in the rotational spectrum of HCl is 20.6 cm^{-1}. Find the moment of inertia and internuclear distance of it. Gram atomic mass of hydrogen is 1.008 g and that of chlorine is 35.45 g respectively.

[2+3+5]